

CLAIMS

1. A downhole hammer drill including:
a drive sub or chuck mounted on an air hammer casing;
and
5 a reverse circulation drill bit having a bit shank mounted in splined relation to said drive sub or chuck and a bit head adapted to extend below said chuck, the air hammer motor exhausting down the splines, an annular groove in said bit shank adjacent said bit head and extending to intersect the lower end of the bit shank splines, a sleeve secured to said bit shank over the lower end of
10 said bit shank splines and substantially closing over said groove to form a manifold for exhaust air exiting said splines, an upper air passage directing sample accelerating air from said manifold up the sample recovery bore of said bit, said bit head having at least one lower air passage therethrough and intersecting said manifold, said lower air passage having a lower end directing
15 air to the cutting face of the bit through an outlet through the side of the bit head adjacent the gauge row thereof communicating with a channel passing from said outlet to said cutting face.
2. A downhole hammer drill according to claim 1, wherein said splines are
20 milled in the bit shank, the milling tool advancing the spline toward the bit head and stopping short of the bit head to avoid the milling tool from removing bit head material.
3. A downhole hammer drill according to claim 1 or claim 2, wherein said
25 groove is formed by milling or turning, said groove forming a progressive change of section between the splined portion of the bit shank and the bit head to avoid stress concentration.
4. A downhole hammer drill according to any one of claims 1 to 3, wherein
30 said sleeve has a section that substantially parallels the bottom surface of the groove to provide that said manifold is of substantially rectangular cross section.

5. A downhole hammer drill according to any one of claims 1 to 4, wherein said sleeve is adapted to cyclically open a port in a sidewall of said chuck to allow exhaust air to escape up the outside of the drill string to clear fines from the borehole.

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6. A downhole hammer drill according to any one of claims 1 to 5, wherein said at least one lower air passage defined between the sample recovery bore and the side of the bit head adjacent the gauge row comprises one air passage for each carbide in the gauge row, the material of the bit head being relieved between the portions supporting the gauge row buttons to form the grooves, allowing the flushing air to pass to the face of the bit, entraining sample for recovery.

7. A downhole hammer drill according to any one of claims 1 to 6, wherein said lower air passage is formed by straight drilling at an angle to the drill bit axis from the side of the bit head adjacent the gauge row and extending to the sample recovery bore above the bit head, whereby a single drilling provides both the lower air passage and the upper air passage.

8. A downhole hammer drill including:
a drive sub or chuck mounted on an air hammer drill casing; and
a reverse circulation drill bit having a bit shank mounted in splined relation to said drive sub or chuck and a bit head adapted to extend below said chuck, the air hammer motor exhausting down the splines, at least one upper air passage opening from the splines in the region of the bit head and inclined toward the axis of the bit away from said bit head, said air passage directing sample accelerating air from said opening up the sample recovery bore of said bit.

9. A downhole hammer drill according to claim 8, wherein spline-borne exhaust air is also directed through the bit head by at least one lower air passage therethrough and intersecting the splines.

10. A downhole hammer drill according to claim 9, wherein said lower air passage has a lower end directing air to the cutting face of the bit through an outlet through the side of the bit head adjacent the gauge row thereof and
5 communicating with a channel passing from the outlet to the cutting face.
11. A downhole hammer drill according to claim 10, wherein said lower air passage is formed as a continuation of the drilling of the upper air passage.
- 10 12. A downhole hammer drill according to claim 11, wherein said upper air passage and lower air passage are co-formed by a drilling from the gauge row at the location of the button, through the bit head and into the shank, to intersect the sample recovery bore.
- 15 13. A downhole hammer drill according to claim 8, wherein said upper air passage is formed by a drilling from the gauge row at the location of the button, through the bit head and into the shank, to intersect the sample recovery bore, and wherein said drilling is counter bored at its lower end to form the carbide button mounting socket.
- 20 14. A downhole hammer drill according to any one of the preceding claims, wherein there is provided a dynamic air seal to the borehole.
15. A downhole hammer drill including:
25 a drive sub or chuck mounted on an air hammer drill casing;
and
a reverse circulation drill bit having a bit shank mounted in splined relation to said drive sub or chuck and a bit head adapted to extend below said chuck, the air hammer motor exhausting down the splines, an exhaust air
30 passage formed in said bit shank adjacent said bit head and adapted to receive air exhausted at the lower end of the bit shank splines, an upper air passage intersecting said exhaust air passage and directing sample accelerating air from

said exhaust air passage up the sample recovery bore of said bit , said bit head having at least one lower air passage therethrough and intersecting said exhaust air passage, said lower air passage having a lower end directing air to the cutting face of the bit through an outlet through the side of the bit head
5 adjacent the gauge row thereof communicating with a channel passing from said outlet to said cutting face.

AMENDED CLAIMS

[received by the International Bureau on 05 October 2004 (05.10.04);
original claims 1, 8, 10-13 amended; remaining claims unchanged (4 pages)]

1. A downhole hammer drill including:
a drive sub or chuck mounted on an air hammer casing;
and
5 a reverse circulation drill bit having a bit shank mounted in splined
relation to said drive sub or chuck and a bit head adapted to extend below said
chuck, an air hammer motor exhausting down the splines, an annular groove in
said bit shank adjacent said bit head and extending to intersect the lower end of
the bit shank splines, a sleeve secured to said bit shank over the lower end of
10 said bit shank splines and substantially closing over said groove to form a
manifold for exhaust air exiting said splines, an upper air passage directing
sample accelerating air from said manifold up a sample recovery bore of said bit
, said bit head having at least one lower air passage therethrough and
intersecting said manifold, said lower air passage having a lower end directing
15 air to a cutting face of the bit through an outlet through the side of the bit head
adjacent a gauge row thereof communicating with a channel passing from said
outlet to said cutting face.
2. A downhole hammer drill according to claim 1, wherein said splines are
20 milled in the bit shank, the milling tool advancing the spline toward the bit head
and stopping short of the bit head to avoid the milling tool from removing bit
head material.
3. A downhole hammer drill according to claim 1 or claim 2, wherein said
25 groove is formed by milling or turning, said groove forming a progressive
change of section between the splined portion of the bit shank and the bit head
to avoid stress concentration.
4. A downhole hammer drill according to any one of claims 1 to 3, wherein
30 said sleeve has a section that substantially parallels the bottom surface of the
groove to provide that said manifold is of substantially rectangular cross section.

5. A downhole hammer drill according to any one of claims 1 to 4, wherein said sleeve is adapted to cyclically open a port in a sidewall of said chuck to allow exhaust air to escape up the outside of the drill string to clear fines from the borehole.

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6. A downhole hammer drill according to any one of claims 1 to 5, wherein said at least one lower air passage defined between the sample recovery bore and the side of the bit head adjacent the gauge row comprises one air passage for each carbide in the gauge row, the material of the bit head being relieved between the portions supporting the gauge row buttons to form the grooves, allowing the flushing air to pass to the face of the bit, entraining sample for recovery.

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7. A downhole hammer drill according to any one of claims 1 to 6, wherein said lower air passage is formed by straight drilling at an angle to the drill bit axis from the side of the bit head adjacent the gauge row and extending to the sample recovery bore above the bit head, whereby a single drilling provides both the lower air passage and the upper air passage.

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8. A downhole hammer drill including:
a drive sub or chuck mounted on an air hammer drill casing; and
a reverse circulation drill bit having a bit shank mounted in splined relation to said drive sub or chuck and a bit head adapted to extend below said chuck, the air hammer motor exhausting down the splines, a plurality of upper air passages each opening from a spline in the region of the bit head and each inclined toward the axis of the bit away from said bit head, said air passages directing sample accelerating air from said openings up the sample recovery bore of said bit.

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9. A downhole hammer drill according to claim 8, wherein spline-borne exhaust air is also directed through the bit head by at least one lower air passage therethrough and intersecting the splines.

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10. A downhole hammer drill according to claim 9, wherein said at least one lower air passage has a lower end directing air to the cutting face of the bit through an outlet through the side of the bit head adjacent the gauge row thereof and communicating with a channel passing from the outlet to the cutting face.

11. A downhole hammer drill according to claim 10, wherein said at least one lower air passage is formed as a continuation of the drilling of each of the upper air passages.

12. A downhole hammer drill according to claim 11, wherein each said upper air passage and lower air passage are co-formed by a drilling from the gauge row at the location of the button, through the bit head and into the shank, to intersect the sample recovery bore.

13. A downhole hammer drill according to claim 8, wherein each said upper air passage is formed by a drilling from the position of a gauge row at the location of a carbide button, through the bit head and into the shank, to intersect the sample recovery bore, and wherein said drilling is counter bored at its lower end to form the carbide button mounting socket.

14. A downhole hammer drill according to any one of the preceding claims, wherein there is provided a dynamic air seal to the borehole.

15. A downhole hammer drill including:
a drive sub or chuck mounted on an air hammer drill casing;
and
a reverse circulation drill bit having a bit shank mounted in splined relation to said drive sub or chuck and a bit head adapted to extend below said chuck, the air hammer motor exhausting down the splines, an exhaust air passage formed in said bit shank adjacent said bit head and adapted to receive

air exhausted at the lower end of the bit shank splines, an upper air passage intersecting said exhaust air passage and directing sample accelerating air from said exhaust air passage up the sample recovery bore of said bit, said bit head having at least one lower air passage therethrough and intersecting said
5 exhaust air passage, said lower air passage having a lower end directing air to the cutting face of the bit through an outlet through the side of the bit head adjacent the gauge row thereof communicating with a channel passing from said outlet to said cutting face.